

Technical Specification 032

EMERGENCY GENERATORS FOR PUMP STATIONS

1.0 General

- a) It is the intent of this specification to secure emergency standby generator systems that have been prototype tested, factory built, production tested, site tested, of the latest commercial design, together with all accessories necessary for a complete installation as detailed herein.
- b) The equipment supplied and installed shall meet the current requirements of the most current edition of the National Electrical Code (NFPA 70), the Standard for Emergency and Standby Power Systems (NFPA 110), and all applicable local and state codes and regulations.
- c) All equipment shall be new and unused and of current production by a firm that has its final assembly located within the continental United States. The generating set manufacturer shall have at least twenty-five (25) years of experience assembling power generating sets.
- d) The engine, generator, controls, and electrical disconnect shall be completely assembled and wired by the generator manufacturer. The manufacturer / supplier must have a locally authorized dealer with factory trained and certified service personnel to ensure one source responsibility for the warranty, parts, and service.
- e) All emergency power generators shall be of the Permanent Magnet Generator (PMG) type construction.
- f) Refer to Brunswick County Technical Specification 033: Automatic Transfer Switch (ATS) requirements.

2.0 Approved Emergency Generator Manufacturers

- a) Equipment and services shall be provided by:
 - 1) Clarke Power Generation
 - 2) Cummins
 - 3) Caterpillar
- b) The supplied engine must be a Cummins, Caterpillar, or Detroit / MTU unit.

3.0 Ratings

- a) The standby generator set shall be rated as standby power defined as continuous operation for the duration of any power outage. Kilowatt ratings for three phase voltages are based upon a 0.8 power factor and single phase voltages are based upon a (1.0) unity power factor. Ratings are established on an altitude of (150) feet and (77) degrees Fahrenheit.
- b) The standby generator shall be sized based upon the total connected load including pumps, control power, lighting, and all miscellaneous loads. The generator shall be able to start the LEAD pump and then start the LAG pump with the LEAD pump running at full speed and all miscellaneous loads adequately supplied.
- c) For pump stations with more than two pumps the generator shall be sized accordingly.
- d) For purposes of this specification, the following Rating Definitions will apply:

Emergency Standby

Generator output available with varying load for the duration of an emergency outage. Minimum average power output is seventy (70) percent of the standby power rating. Standby power shall be in accordance with ISO 8528.

Standby

Generator output available with varying load for the duration of the interruption of the normal source power. Minimum average power output is seventy (70) percent of the standby power rating. Standby power shall be in accordance with ISO 8528 and ISO 3046.

Prime

Generator output available with varying load for an unlimited time. Minimum average power output is seventy (70) percent of the prime power rating. Prime power shall be in accordance with ISO 8528 and ISO 3046.

Continuous

Generator output available without varying load for an unlimited time. Average power output is 70 – 100 percent of the continuous power rating. Continuous power shall be in accordance with ISO 8528 and ISO 3045.

4.0 Required Submittals

- a) The utility contractor shall submit the following to the Engineer for review and approval prior to supplying any emergency generator set:

- 1) Five sets of submittal data shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams; dimension drawings; and interconnection diagrams identifying by terminal number each required interconnection between the generator set and an automatic transfer switch for all permanent mounted gensets. Submittal drawings for permanently installed units shall clearly show concrete pad dimensions and mounting details.
- 2) A marked-up copy of this specification with notations clearly showing all deviations and/or exceptions to this specification for the submitted unit – if any deviations.
- 3) Voltage drop calculations under worst case motor starting for loads on the plan. When motor loads are not specified in the bid documents, the bidder shall provide available SKVA @ twenty-five (25) percent instantaneous voltage dip.
- 4) A letter detailing local service capability, factory trained serviceperson(s) credentials, and the specified service response per this specification.
- 5) Enclosure paint color samples for owner selection. Preferred colors are camel, neutral tan, grey, or white. Green is not a Brunswick County color option.
- 6) Testing results.

5.0 Codes and Standards

- a) The generator set shall conform to the following current codes and standards:
 - 1) IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
 - 2) NFPA70 – National Electric Code. Equipment shall be suitable for use in systems in compliance with Article 700, 701, and 702.
 - 3) NFPA 110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit – component level type tests will not substitute for this requirement.
 - 4) UL 2200 – The genset shall be listed and labeled to UL 2200.
 - 5) ISO 8528 – Reciprocating internal combustion engine alternating current generating sets.
 - 6) NEMA MG-1: 2006 Motors and Generators.

- 7) NEMA MG-2: Standard for construction and guide for selection, installation, and use of electric motors and generators.

6.0 Testing

- a) To assure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.

- b) Design Prototype Tests:

Components of emergency systems such as the engine/generator set, transfer switch, and accessories shall not be subjected to prototype tests since the tests are potentially damaging. Rather, similar design prototypes and preproduction models, which will not be sold, shall have been used for the tests. Testing shall be performed to nameplate ratings and prototype test programs shall include the requirements of NFPA 110 and the following:

- 1) Maximum power (kW)
- 2) Maximum motor starting (SKVA) at 25% instantaneous voltage dip
- 3) Alternator temperature rise by embedded thermocouple and by resistance method per NEMA MG-1: 22.40
- 4) Governor speed regulation under steady-state and transient conditions
- 5) Voltage regulation and generator transient response
- 6) Fuel consumption at 1/4, 1/2, 3/4, and full load
- 7) Harmonic analysis, voltage waveform deviation, and telephone influence factor
- 8) Three-phase short circuit tests
- 9) Alternator cooling air flow
- 10) Torsional analysis testing to verify that the generator set is free of harmful torsional stresses
- 11) Endurance testing

- c) Final Production Tests:

Each generator set shall be tested under varying loads with guards and exhaust system in place. Testing shall be performed to nameplate ratings and tests shall include:

- 1) Single-step load pickup
- 2) Transient and steady-state governing
- 3) Safety shutdown device testing
- 4) Voltage regulation
- 5) Rated power
- 6) Maximum power
- 7) Upon request, arrangements to either witness these tests will be made, or certified test records will be sent prior to shipment.

d) Site Tests:

Installation checkout, start-up, and load bank tests shall be performed by the manufacturer's local representative. The Engineer, utility contractor, electrical contractor, and County staff shall be notified of the time and date of the site tests with a minimum forty-eight (48) hours advance notice. The tests shall include:

- 1) Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations under the environmental conditions present and expected.
- 2) Accessories that normally function while each set is standing by shall be checked prior to cranking the engines. These shall include: block heaters, battery chargers, generator strip heaters, etc.
- 3) Start-up test mode to check for exhaust leaks, path of exhaust gases outside buildings, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage, and phase rotation.
- 4) Four hour load bank test with an external load bank as follows: 1 hour @ 25% load, 1 hour @ 50% load, 1 hour @ 75% load and 1 hour @ 100% load, monitor and record the following data in 15 minute intervals: engine coolant temperature, oil pressure, battery charge level, generator output voltage, amperes, and frequency.
- 5) NFPA-110 testing with an external load bank connected to the system to load the generator to the nameplate kW rating with verification of single-step load pickup
- 6) Perform automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, test unit under actual load by starting both pumps sequentially along with all additional miscellaneous loads, and automatic shutdown. Engine coolant

temperature, oil pressure, and battery charge level along with generator voltage, amperes, and frequency shall be monitored throughout the test.

7.0 Warranty and Service

- a) The emergency generator systems shall be warranted at a minimum for (1) year or 3,000 run time hours, whichever occurs first, from the date of startup to be free from defects in material and workmanship in accordance with the manufacturers published warranty. During the warranty period all required replacement parts and labor shall be furnished at no additional cost to the County.
- b) The engine – generator distributor shall provide semi-annual servicing of the generator throughout the warranty period at no additional cost to Brunswick County. The engine-generator distributor shall furnish factory trained and certified personnel and maintain a 24-hour parts and service capability, and show, at time of submittal, that they are regularly engaged in a maintenance contract program to semi-annually inspect and test run the engines to perform manufacturer's recommended preventative maintenance service on the equipment furnished. This service agreement shall include operation of the equipment under simulated power failure conditions, adjustment of generator, transfer switch (where included), as required, and certification in the County's maintenance log of repairs made and proper functioning of all engine and auxiliary systems. At the County's option, the service agreement shall be renewable on a year-to-year basis, thereafter, with costs being paid by the County.
- c) Service Response: A factory certified service shop shall be located within a two-hour and / or one hundred (100) mile radius of the Brunswick County Utilities Field Operation Center in Supply, North Carolina. Service response shall be guaranteed to be eight hours or less upon receipt of service call notification.
- d) Manuals: Three paper sets and one digital copy of all operating and maintenance instruction manuals specific to the equipment shall be supplied for the engine, generator, governor, voltage regulator, and auxiliary system components as specified herein. No generic manuals will be accepted. Each manual must be clearly marked to identify the site where the generator set is installed.

8.0 Generator

- a) Each standby generator set shall be rated continuous standby (defined as average power output of 70% of the standby power rating) for the duration of any interruption of the normal source power), for the voltage specified in the plans or within the contract documents, 3 phase, 4 wire, 60 Hz, 80% power factor at a maximum altitude of 150 feet altitude and 77 degrees F.
 - 1) Oversized alternators shall be provided as required for motor starting capability.
 - 2) Each generator set shall be capable of starting motor loads as specified in the plans or within the contract documents, with a maximum instantaneous

voltage dip of 25%.

- 3) The generator shall power pump station components with all pumps sequentially started along with some all miscellaneous loads. Maximum voltage dip shall be determined for worst case scenario (full load demand).
- 4) The generator set shall be capable of supplying the specified SKVA for starting motor loads plus other site connected loads with a maximum instantaneous voltage dip of 25%, as measured by a digital RMS transient recorder in accordance with IEEE Standard 115. Motor starting performance and voltage dip shall be in accordance with MG-1, Section II, and 16.48.1. Motor starting performance and voltage dip based on 90% sustained voltage is not acceptable.
- 5) The engine – generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.
- 6) Integral vibration isolators shall be provided between the engine-generator and the skid-base. Additionally, vibration pads shall be furnished loose for installation between the skid-base (or tank when a sub-base tank is included) and the concrete pad.

9.0 Engine

- a) The prime mover shall be a liquid-cooled, #2 diesel fueled engine of 4-cycle design, shall be a Cummins, Caterpillar, or Detroit/MTU unit, and shall be equipped with the following items:
 - 1) Mechanical or electric fuel transfer pump, primary and secondary fuel filters, water separator, and electric fuel shut-off valve.
 - 2) Electronic isochronous governor capable of regulating the no load to full load frequency to +/- 0.25% steady state frequency regulation.
 - 3) 12-volt or 24- volt positive engagement solenoid shift-starting motor.
 - 4) 12-volt or 24-volt belt driven battery charging alternator with solid state voltage regulation.
 - 5) Replaceable sleeved cylinders (applicable to 30 – 400 kW generator sets).
 - 6) Two flexible fuel lines rated 300 degrees F and 100 psi ending in pipe threads.
 - 7) Engine unit must be fitted with a fuel / water separator
 - 8) Dry replaceable, air cleaner with an Air Cleaner Restriction indicator.

- 9) Positive displacement full pressure lubrication oil pump, cartridge oil filters, dipstick, and crankcase oil drain.
- 10) Unit-mounted radiator, pusher type cooling fan, water pump, thermostat, and radiator duct flange (non-enclosed units) shall properly cool the engine and be designed for operation at a minimum ambient temperature of 122 degrees F (50 degrees C). Radiator (on non-enclosed units) shall include a duct flange adapter for connection to the discharge air vent.
- 11) Batteries capable of delivering the manufacturer's recommended minimum cold-cranking amps required at 0 degrees F, per SAE standard J-537, shall be supplied along with the required battery rack(s) and battery cables mounted within the generator weather protective enclosure. Batteries shall be the Augmented Glass Mat (AGM) type with corrosion resistant tin plated brass terminals. Preferred battery: Odyssey, Group 31, 1,150 minimum cold cranking amps.
- 12) Ten (10) ampere automatic float and equalize battery charger, approved for use with AGM type batteries, with +/-1% constant voltage regulation from no load over +/-10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambients from (-) 40degrees C to (+) 60 degrees C, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected. Alarm circuit board to meet the requirements of NFPA-110 for low battery voltage, high battery voltage, and battery charger malfunction shall be provided and wired to provide annunciation on the control panel. Battery charger shall be 3rd party listed and shall be mounted within the generator set enclosure. All DC wiring shall be installed at the generator set factory and AC wiring shall be furnished by the generator set installer.
- 13) The generator set supplier shall furnish lubricating oil to fill the crankcase as recommended by the manufacturer.
- 14) The generator set supplier shall furnish 50% ethylene glycol antifreeze solution to fill the engines cooling system.
- 15) Block heater shall be compliant with NFPA – 110 requirements for Level I equipment for heater capacity, 120 VAC, and shall be thermostatically controlled. Block heater(s) shall be 3rd party listed. Higher wattage and voltage may be required for larger generators.
- 16) Gas proof, stainless steel, flexible exhaust bellows with connections compatible with the engine and silencer shall be supplied on the unit.
- 17) Critical grade exhaust silencer(s) shall be provided with internal thermal insulation. Externally mounted exhaust silencers shall be stainless steel. Exhaust silencers shall provide attenuation for compliance with the generator enclosure sound pressure level specified in Section 12 – Generator Enclosure – of this specification.

- 18) Each engine shall be equipped with pre-alarm switches and safety shutdown switches to protect the engines from the following conditions:
- a) Low oil pressure pre-alarm
 - b) High coolant temperature pre-alarm
 - c) Low coolant temperature pre-alarm
 - d) High coolant temperature shutdown
 - e) Low coolant level shutdown
 - f) Low oil pressure shutdown
 - g) Overspeed

10.0 Alternator

- a) The alternator shall be a 4-pole revolving field type with (12) reconnectable leads, self-ventilated and of drip-proof construction. The insulation material shall meet the NEMA standard (MGI- 22.40 and 16.40) for Class H insulation. The excitation system shall be of brushless construction controlled by a solid-state voltage regulator with adjustable volts-per-hertz tracking. The alternator shall be the Permanent Magnet Generator (PMG) type with a permanent magnet rotor with the associated voltage regulator for PMG field excitation and output voltage regulation. The alternator shall be provided to prevent damage due to any external fault or overload condition.
- b) On application of any load up to the full rated load at 0.8 power factor (PF) the voltage dip shall not exceed 12.5% and shall recover to stable operation [(+ / -)] 1% of rated voltage) within two (2) seconds. The alternator shall be capable of sustaining at least 250% of rated current for at least ten (10) seconds under a three (3) phase symmetrical short by inherent design or by the addition of an optional current boost system. The alternator shall be capable of accepting the loads and instantaneous voltage dip when loads are started as specified.
- c) The voltage regulator must be capable of maintaining voltage within (+/-) 1% at any constant load from 0 to 100% of rating. The regulator must be isolated to prevent tracking when connected to SCR loads, and provide individual adjustments for voltage range, stability, and volts-per-hertz operation, and be protected from the environment by conformal coating.
- d) The generator shall be directly connected to the flywheel housing and by means of a shaft through a flexible drive plate coupled between the alternator's rotation mass and the engine flywheel for permanent alignment. Grounding and bonding shall be in accordance with local codes.
- e) The generator set shall be furnished with a mainline circuit breaker(s), 100% rated, and sized to allow full generator set output rated amperage unless otherwise specified.

Breakers on 480 VAC systems shall have GFI (indication only) on breakers rated 1,000 amperes and larger. The breaker(s) shall have a DC shunt trip activated on engine or generator fault and shall be mounted on the side of the alternator conduit box. Adequate space shall be provided for the installation of all required conduits at the generator. All conduit connections at the generator shall utilize flexible conduit to prevent vibration damage.

11.0 Fuel System

- a) Double wall, steel, sub-base mounted fuel tank shall be provided adhering to UL code 142 requirements. There shall be a leak detection switch located in the outer tank to detect any leakage between the tanks, and this occurrence shall indicate on the generator control panel.
- b) The fuel tank shall have provisions for lifting when the tank is empty. The tank shall contain fuel sufficient for a minimum forty-eight (48) hour run time at one hundred (100) percent load.

Note: some applications shall require a larger fuel supply tank at the discretion of Brunswick County Public Utilities.

The tank will be fitted with a fuel fitting to remove the diesel fuel from the tank. There shall also be a lockable fuel filler cap and suction and return piping. Consideration shall be given in the upper plate design to ensure free and easy access to the vibration mount hardware that connects the generator to the top of the fuel tank. There shall be an electrical access area for conduit access to the alternator connections. Fuel tanks larger than the minimum capacity specified are also acceptable.

- c) A concrete mounting base shall be furnished by either the utility contractor or the generator installer such that the top of tank shall be a minimum of thirty (30) inches above grade to aid in preventing flood damage to the engine.
- d) The tank shall feature all welded construction and have the structural integrity to support the genset, accessories, and the weather-protective enclosure. The exposed tank top shall be peaked to direct water runoff away from all components.

12.0 Generator Enclosure

- a) Sound attenuated, drip-proof, weather protective enclosure shall be constructed of marine grade 5052, minimum 0.090 gauge, aluminum alloy.
- b) The enclosure shall be primed and have a powder coat baked paint finish. Acceptable paint colors shall be a camel, neutral tan, grey, or white – green is not allowed.

- c) The Sound Attenuated Enclosure, along with the internally mounted critical grade, stainless steel, insulated silencer, will maintain a sound pressure level not to exceed seventy-five (75) dBA at twenty-three (23) feet when the generator set is operating at full load.
- d) The enclosure shall be fabricated and mounted to the sub-base fuel tank by the generator manufacturer. A neoprene sealing / isolation joint shall be furnished between the enclosure and sub-base tank. The enclosure roof shall be peaked to direct water runoff away from all components. All enclosures shall have stainless steel hardware throughout. All enclosures shall be rated at a minimum for a (150) mph wind load.
- e) The enclosure shall have a removable panel at the radiator end to allow access to the interior mounted exhaust silencer and for maintenance and cleaning of the radiator cooling fins. Two doors per side shall be provided for operator and service access. Hinges shall allow the doors to swing open or be removed easily for access and service. Door clips, or similar means, shall be provided to secure the doors to the sides of the enclosure to prevent accidental shutting or injury to the operator or maintenance staff. Access to the controller and main line circuit breaker must meet the requirements of the National Electric Code (current edition). All door locks shall be stainless steel and shall be keyed alike with CH-751, or as directed by Brunswick County Public Utilities staff.
- f) Cooling and combustion air shall enter the enclosure through wire screened panels. Engine exhaust gases and cooling air shall discharge horizontally or vertically (as indicated on the plans) through a screened opening.

13.0 Controller and Gauge Panel

- a) The generator set shall be provided with a microprocessor based control system designed to provide the following features and functions:
 - 1) The Generator Control Module (GCM) shall be mounted within the generator set and provide a suitable operator control panel. The control panel shall provide vibration isolation as necessary to the mounted controls to provide trouble free operation.
 - 2) The genset control shall have selector functions for automatic operation, manual operation, cool down mode, stop mode, and off-reset for shutdown faults plus interface logic with the engine auto start / stop cranking controls as follows:
 - a) Automatic - upon receipt of an input contact signal (locally or remote), genset to be signaled to start and to attain operating voltage / frequency.
 - b) Manual - genset to be signaled to start and to attain operating voltage / frequency by use of a manual start switch.

- c) Stop and cool down - generator breaker to trip open and genset to continue to run unloaded for a preset cool down time period prior to actual shutdown.
 - d) Off - if genset shuts down due to activation of a protective device then a shutdown malfunction circuit shall be latched and will require a manual reset before genset can be re-started. An operating genset shall shutdown with tripping of the generator breaker when OFF-RESET is activated.
- 3) Monitoring and control functions for the generator set shall be provided:
- a) Local monitoring and control shall be provided on the generator set operator control panel.
 - b) Control system shall have the capability for remote monitoring and control with the use of additional hardware, components, and cabling.
 - c) GCM shall provide detailed event and performance logging with capabilities to capture one hundred (100) or more events.
 - d) Upon alarm or shutdown, the GCM shall have the capability to generate and send messages compatible with the existing Brunswick County SCADA system. An RS-232 interface shall be provided on the controller.
 - e) Automatic annunciation or shutdown for generator set warning or alarm functions
- 4) GCM control functions:
- a) The control system shall include an engine cycle cranking system with adjustable settings for:
 - 1) Pre Start Delay Time
 - 2) Maximum Crank Time
 - 3) Pause time between crank attempts
 - 4) Idle time
 - 5) Cool down time
 - b) The control system shall include an engine governing control to provide steady state frequency regulation. The governor shall include adjustments for gain, dampening, and ramping functions

to control engine speed if not provided by the engine control module supplied by the engine manufacturer.

- c) The control system shall include adjustable time delay functions for:
 - 1) Time delay for start
 - 2) Time delay for stop
- 5) Controller Operator Display
 - a) The generator set controller shall have the following operator display features at a minimum:
 - 1) Backlit graphical LCD display 64x128 pixel resolution minimum.
 - 2) Genset status LEDs shall provide the following indications:
 - a) Alarm - Preferred color is Red
 - b) Not In Auto - Preferred color is Red
 - c) Warning - Preferred color is Yellow
 - d) Running - Preferred color is Green
 - e) Ready / Auto - Preferred color is Green
 - f) Supplying Load - Preferred color is Green
 - 3) The controller panel shall be a sealed membrane type. Sealing shall meet IP64 and have operator keys for the following control functions:
 - a) Start
 - b) Stop
 - c) Fault Reset
 - d) Horn Reset
 - e) Data Entry - Mode, Page Up, Page Down, and Enter
 - 4) The genset controller shall display the following engine metering and protection functions:
 - a) Running Hour Meter
 - b) Over Speed Shutdown

- c) Low Oil Pressure Warning
 - d) Low Oil Pressure Shutdown
 - e) High Coolant Temperature Warning
 - f) High Coolant Temperature Shutdown
 - g) Low Coolant Temperature Warning
 - h) Low Fuel Level Warning
 - i) Low Fuel Level Shutdown Capabilities For 4 Programmable Analog Input Protection
- 5) The genset controller shall display the following generator set metering and protection functions:
- a) Under / over voltage
 - b) Over / under frequency
 - c) Voltage unbalance
 - d) Current unbalance
 - e) Over Frequency
 - f) Under Frequency
 - g) Over Current
 - h) Over Load
 - i) IDMT Protection
- 6) The genset controller shall display the following generator set output metering functions:
- a) AC amperes for each phase
 - b) AC voltage for each phase
 - c) Frequency
 - d) Kilowatts, 3 phase
 - e) kVARS, 3 phase

- f) kVA, 3 phase
 - g) Power factor
 - h) Kilowatt hours, 3 phase, accumulative
 - i) kVAR hours, 3 phase, accumulative
- b) Common Alarm
 - 1) A common remote audible alarm function will be provided so that a horn output will occur. The horn shall be battery powered and resettable from the operator control panel and any remote annunciator. The horn will activate if any of the following conditions occur:
 - a) Over Crank Alarm
 - b) Low Coolant Temperature Warning
 - c) High Coolant Temperature Warning
 - d) High Coolant Temperature Alarm
 - e) Low Oil Pressure Warning
 - f) Low Oil Pressure Alarm
 - g) Over Speed Alarm
 - h) Not In Automatic Warning
 - i) Low Cranking Voltage Warning
 - j) Low Coolant Level Alarm
- c) Run Relay
 - 1) A ten (10) Amp relay with 120 VAC / DC rated contacts shall be supplied to indicate the genset Run condition. The dry contacts shall be Form C and shall have connection to a terminal strip for easy interface to other control systems.
- d) Communications
 - 1) The GCM shall be capable of communicating over J1939 or Modbus RTU with electronic engine modules (ECU) within a distance of 200 meters.
 - 2) The GCM shall provide MODBUS RTU communication over both RS232 and RS485.

- 3) The GCM shall provide MODBUS TCP communication over RJ45 connection.
 - 4) The GCM with extension modules shall be capable of providing remote monitoring capability over Ethernet utilizing HTTP or SNMP protocol.
- e) Hardware Specifications
- 1) Operating temperature range of the GCM shall be at a minimum -30C to +70C.
 - 2) The GCM must be capable of monitoring speed via mag pickup, frequency based, or J1939 / CAN speed signals.
 - 3) The GCM will support five (5) ampere secondary CT output current.
 - 4) The GCM will allow for direct voltage measurement up to 480 VAC line to line.
 - 5) The GCM will have a minimum of seven (7) on board open collector type Digital/Binary outputs, with expansion capabilities.
 - 6) The GCM will have a minimum of 7 on board Digital/Binary inputs with a minimum two (2) volts level for closed contact indication; with expansion capabilities.
 - 7) The GCM will have a minimum of three (3) on board analog inputs that support 0-2500 ohm analog inputs, with expansion capabilities.

14.0 Accessory Required Items

- a) The following items must also be furnished by the generator supplier and /or installer:
- 1) Oil and water drain lines shall be installed and extended to the outside of the weatherproof enclosure through bulkhead fittings. Each drain line shall include a brass ball valve and flexible lines. The ball valves shall be located on the interior of the packaged equipment.
 - 2) Duplex service receptacle, 110 VAC, 20 ampere, GFCI protected, with two (2) separate 20 ampere branch circuits supplying the receptacle, one circuit for the engine block heater and the second circuit for the battery charger, each 20 ampere circuit shall be on its own branch circuit breaker.
 - 3) Emergency stop button, red, mushroom head type, to be installed as directed by Brunswick County Public Utilities staff, depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.